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THE FAIRHAVEN, MASS. WATER WORKS.

— BY —

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Superintendent.

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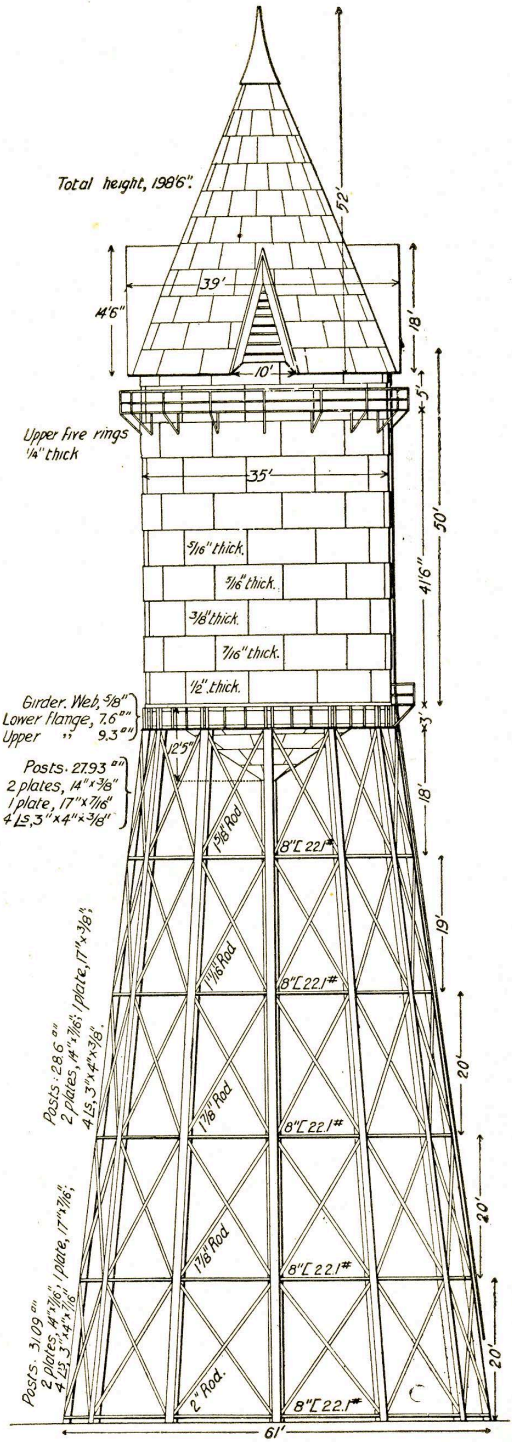
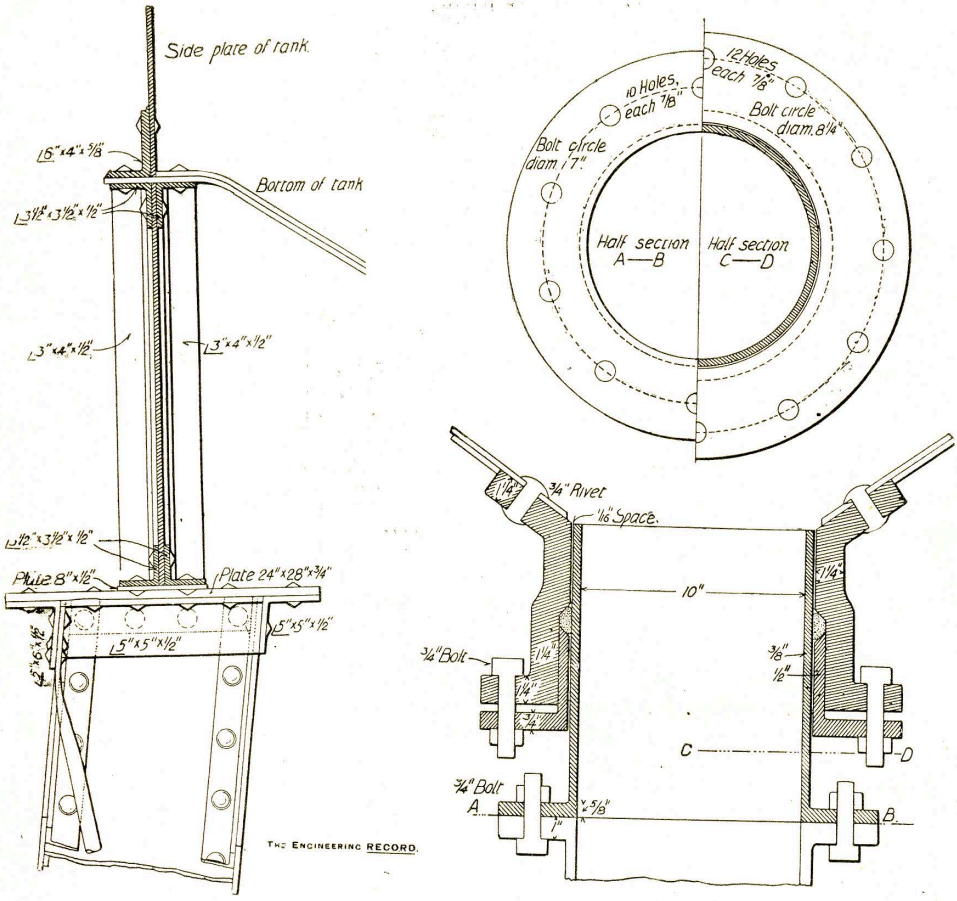
In 1857 the little village of Fairhaven, situated in the extreme Southeastern portion of Massachusetts, opposite the city of New Bedford, was a thriving, prosperous whaling port. Business was more than good, profits large, and money was plenty. The town boasted a considerable number of wealthy men who gave freely to public benefits, and the solid granite wharves, fine churches and beautiful elm shaded streets, have been handed down as evidence of the prosperity of those good old times. But about this time the great army of whalers met the skirmish line of their enemy—petroleum. The battle that followed was short and it took only a few years to nearly wreck the whole village, not however, until glorious plans for public improvement had been made. Water, sewers, gas, etc., had all been in project, but all went down in the general crash. Water would however have been introduced, had it not been for one difficulty. No water could be found. The town had voted to secure the services of an engineer who should report upon the possibilities of a water supply, and weary from his tramp over dry fields and out-cropping ledges he gave it up in dispair, and reported the idea impossible. In his travels the engineer walked over the spot where now stands the handsome little Pumping Station of the Fairhaven Water Co. Where today we have twenty-six wells flowing over the top of the driven pipe of their own natural head 10,000 gallons per day each. Sometimes great results come from small happenings, and the small happening that resulted in the building of the Fairhaven Water Works was a very wet jacket on a small boy who skated into what they afterwards told him was an "air hole" in the ice on the little Naskatucket brook. The jacket was very wet, but the subsequent warming it got was sufficient to squeeze from it, with the addition of a few tears, a bountiful town supply. The "air hole" proved to be the out-cropping of a large quantity of subterranean water, and in 1893, fifteen years after the above named suffering circumstance, twenty-six $2\frac{1}{2}$ inch tubes were pouring their supply to the surface.

The plant of the Fairhaven Water Works is, of course, nothing more than the usual pump and stand pipe system, but it contains some unusual engineering features that I think will be of interest to the members of this Association. The distribution consists of about fourteen miles of 12, 10, 8 and 6-inch pipe, the plan of the system represents almost exactly the wires of an ordinary toasting iron or grid. The one and one-half mile of 12-inch force main being the handle and the crossing of the 10, 8 and 6-inch representing the wires or grid.



STAND PIPE, FAIRHAVEN WATER WORKS.



DETAILS OF STAND PIPE, FAIRHAVEN WATER WORKS.

would require 1⅜-inch plate in the bottom course and would cost not less than $33,000 and probably $35,000 complete. It was finally decided to build a tank 35 feet in diameter and 50 feet high, and support it by a framed steel base 100 feet high. The cost of this is practically $19,000 with foundations and roof. The capacity when full is about 383,000.

The tank itself differs in no way from any ordinary well designed tank or stand pipe, except in construction of the bottom which was made in the form of an inverted cone. This was done to avoid centre supports or cross girders and transfer the strains caused by the weight of water to the outside of the tank where it was supported by the posts. The bottom plates are put in circular rings or courses with radial joints. The roundabout seams are lapped and double riveted, and the radial seams have butt joints with single color plates, and are also double riveted.

The outer course of the bottom plates are ½-inch in thickness as are the lower course of side plates and pass under the latter and project ½ inch beyond the angle iron which forms the connection between the sides and bottom and are riveted to it. The courses of bottom plates decrease regularly in thickness toward the center where the inlet and outlet pipe enters through a composition stuffing box, which allows for expansion and contraction or any movement of the pipe. This pipe is 12 inches in diameter, of wrought iron and secured at two points by braces to the steel frame. Its weight and that of the water it contains are supported in the ground by a heavy casting. There is a balcony around the top of the tank, and a balcony landing at the bottom near the man hole, which are constructed entirely of wrought iron.

The water supply being from an underground source, it was necessary to cover the tank to keep out the light, and a steep conical roof was constructed for the purpose. The sides of the roof make an angle of 63°—26′ with the horizon, or the rise is equal to the diameter. The covering of the roof is of ⅛-inch galvanized plate, lapped and riveted on horizontal courses and riveted to the circular angle iron ribs which form the frame of the roof. There are four dormer windows with ventilating slides made with slats, which raise and lower to give access to the interior. There are also openings for ventilation about the tank under the jet, and at the extreme top by an opening under the base of the finial.

The base is 100 feet high from the coping stone of the foundation to the top of the circular girder upon which the tank rests. It is composed of twelve posts set in a circle, the diameter of which is 35 feet at the top and 61 feet at the bottom. The posts are connected with each other at points 20 feet apart by 6-inch channell iron ties, which prevent the posts from spreading and give them a lateral support at these points, thus reducing the span of the posts between points to 20 feet. The posts are also braced and counter braced at these points by 2-inch steel rods and turn buckles, to resist the overturning tendency of the wind. The ties and braces are all connected together and to the posts by a plate or gussett. The posts are in the form of a plate girder in section, with 17-inch web and 14-inch flanges made up of

plates and angle iron from $\frac{5}{16}$ to $\frac{1}{2}$-inch in thickness, the area of cross section increasing from top to bottom to provide for the increased strains due to the wind at the lower portion of the base. The top of the base is surmounted by a circular plate girder with 36-inch web and 8-inch flanges. This is designed to carry the whole strain caused by the weight of the tank and the water to the heads of the posts which are about 9 feet apart on centres at the top.

The foundation piers, one at each post, are built of rubble masonry laid in cement, and are 9 feet square at the bottom and 6 feet square on top with a coping stone 4 feet square and 15 inches deep, the top of which are hammered to receive the feet of the posts which are a plate 26x28 inches and 1 inch thick. The foundations are designed to bring a pressure of not over three tons per square foot as a maximum when the tank is full and with a wind pressure of fifty pounds per square foot. The earth is a hard pan or clayey gravel. The ground under the tank to the outside of the foundations is to be covered with coal tar concrete to prevent the washing away of the earth around or under the foundation in case of accident to the supply pipe. This stand pipe was designed in the office of M. M. Tidd, by Mr. Freeman C. Coffin, his principal asssistant, and was built by Messrs. Riter & Conley of Pittsburgh.

As everything about the system has been selected, not so much with regard to expense as utility, I think we can safely claim to have one of the best, if not the best, designed and built small systems in New England.

DISCUSSION.

MR. FITZGERALD. I should like to ask if any test was made of the yield of those wells?

MR. NYE. We pumped from them at the rate of about 500,000 gallons a day for fourteen days; that is the only test ever made before we built the works. Since that time we have pumped 1,500,000 gallons in fifteen hours without reducing the head or flow of the wells. This was in a very wet time.

MR. FITZGERALD. In pumping 500,000 gallons a day for founteen days, how much did it lower the head in the ground.

MR. NYE. It did not reduce the head more than three inches.

MR FITZGERALD. Practically it did not reduce it at all.

MR. NYE. No; it came back inside of three minutes after stopping the pump.

MR. FITZGERALD. What time in the year was it?

MR. NYE. It was in November, and the rainfall had been very light that year.

MR. TIDD. I think Mr. Nye has covered the entire subject. It seems to me, so far as the works are concerned, that they are a success in every way. There are some novelties about the standpipe which may be interesting to members of the Association; and I will say the credit of that design is due principally to Mr. Coffin, who was my assistant at that time, and who substantially designed it. Mr. Nye informs me he was up in it last fall during

one of the severest gales we had, and, as I understood him to say, there was positively no movement felt.

MR. NYE. A very slight vibration inded. but a terrific noise.

MR. COFFIN. I think Mr. Nye's description of the standpipe covers it completely. I would say it is a design the strains of which can be calculated, as well as in any structure. Although it is a novelty, I think it is designed on correct principles; and, as I say, the strains could all be figured, except there might be a question of opinion as to the wind strains on the bracing, because the posts are set in a circle, and it would be a matter of judgment how many of the sections the wind strain would come on. Of course it would come squarely on two side sections from which ever way the wind blew, and it is a matter of judgment, I should say, how much would be borne by the other sections. Two side sections would not bear anything, of course.

The first design was made with the posts of Z bar columns; but on consulting with the builders they said that at that time, it was almost impossible to obtain Z bar columns from the mills in any reasonable time, and that they cost more, and suggested the form it was put into with one plate girder; and although it is probably not quite as economical a form of material as Z bar columns, and we made them a little heavier than we would have with Z bar columns, still I think possibly it may be as well. The girder at the top is 39 inches deep. It is a circular girder, made very much like a plate girder-except that in plan it is circular, and all the weight of the water in the stand, pipe comes upon this it, and is transferred to the heads of the posts which are 9 feet apart on centres; and the girder was figured to carry that strain.

The great object, of course, in making this standpipe in this shape was the saving in cost. It was so high that a standpipe of the same cost probably would not have been more than 18 or 20 feet in diameter. I don't know as I have looked into that with sufficient care to state positively; but a standpipe of this same character, carried to the ground as a standpipe, would have cost nearly twice as much as this one did, without the foundation and without the roof. That is the advantage, in this form, namely: the saving of money. It is a novelty, of course and I am naturally interested to see how it comes out.

MR. BRACKETT. I should like to ask Mr. Coffin if there is any question in constructing a standpipe 150 feet high, of the practical use of the very heavy plates which are necessary, that is in the manufacture; having in mind, perhaps, the accident at East Providence?

MR. COFFIN. I should not want to speak positively about a thing of that kind, but it seems to me I should avoid using plates heavier than one inch, especially if all the seams were to be made lapped seams. For where three plates come together, as they do where the longitudinal joints are lapped and then a vertical joint laps on to them, there is a corner which has to be beaten down, and that has to be heated in place by some kind of a basket heater, and it seems to me it must occasion some severe strains.

Then there is another point. I don't know how the rolling might affect such thick sheets. Of course in a standpipe of that diameter there would

never be very much strain, perhaps; and it is my opinion that certainly all sheets above three-quarters of an inch should be drilled instead of punched, because the drilling would not affect the structure of the iron or steel. The tank part of the standpipe was designed to be of iron; in fact it was designed to be all of iron, except the posts, the compression members. I think, as I said before, all plates over, three-quarters of an inch should be drilled instead of punched; and, I should want to avoid using plates over one inch thick.

MR. NYE. I would like to say the wells in our system were driven under the direction of Mr. Daniel Russell.

MR. TIDD. This standpipe was constructed of iron, and I have always preferred iron to steel from the fact I had rather have the best quality iron than the very poorest quality of steel. I have noticed that all the standpipes in the country that have fallen have been of steel, while I know of no instance of an iron one falling.

MR. COGGESHALL. I would say one word about the appearance of this stand pipe. Most standpipes are blots on the landscape, as we all know, but this on the contrary, is a very sightly structure as we see it from New Bedford.